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Waste Reduction Assistance Program (WRAP) On-Site Consultation Audit Report: Fur Dressing/Tanning Shop

Alaska Health Project, Anchorage

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WASTE REDUCTION ASSISTANCE PROGRAM (WRAP)

ON-SITE CONSULTATION AUDIT REPORT

FUR DRESSING/TANNING SHOP

JULY 12, 1988

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16. Abstract (Limit: 200 words)

This document reports on an environmental audit of an Alaskan fur dressing tannery. It reviews the shop's processes and identifies the hazardous wastes produced and their causes, identifies common waste management practices and their costs, and presents extensive waste reduction alternatives.

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READERS NOTE:

The information contained herein is intended to be general guidance for the facility described in this report and the industry as a whole. It is the product of approximately 6 to 8 hours of on-site consultation with the facility owner. The focus of the report is waste management and waste reduction, not regulatory compliance. Regulatory issues mentioned are discussed only insofar as they impinge on management issues related to hazardous waste management and waste reduction, and are not part of a comprehensive discussion about all pertinent regulation requirements. Waste determinations were made from available data, no on-site sampling took place. Managers interested in specific information on hazardous waste regulations should contact the nearest Environmental Protection Agency or State Department of Environmental Conservation office. Waste reduction measures are described briefly and should be further evaluated and balanced against the unique conditions of each specific business.

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I. Introduction

A. The Waste Reduction Assistance Program (WRAP)

The Waste Reduction Assistance Program is designed to help small businesses reduce industrial waste through educational programs and on-site waste audits. Audit reports focus on the elimination of waste through source reduction and recycling wherever possible. The program is funded by a Resource Conservation and Recovery Act (RCRA) 8001 grant awarded by the United States Environmental Protection Agency (EPA) to the Alaska Health Project, a non-profit organization located in Anchorage, Alaska.

After on-site audits are conducted, individual reports are written describing the process used and wastes produced by the particular business. Each report then recommends methods for reducing these wastes. The identity of the business remains confidential. The audits are intended to be applicable to other similar businesses in Alaska. Audit reports are available to interested parties upon request.

This WRAP report presents an audit of an Alaskan fur dressing tannery . The report goals are to:

1) Analyze waste generation at a tanning (fur dressing) shop in Alaska and publish the findings in a report.

2) Provide a format for other tannery shops and businesses to conduct their own environmental audit.

3) Identify the industrial wastes produced in the tanning shop and the process by which they are generated.

4) Make recommendations, if appropriate, to reduce the amount of hazardous wastes generated.

5) Identify common waste management practices and advise on possible better methods to store and ship hazardous wastes.

6) Analyze the cost benefits of the waste reduction methods recommended in this report.

All recommendations, information, and cost data are subject to change. They will not reflect the future market conditions, regulatory climate and changes in shop processes. This report offers only general guidance to other small quantity generators and all the information provided should be balanced against the unique conditions of each specific business.

This report was written by a graduate student under the direction of the Alaska Health Project and the University of Alaska, Anchorage School of Engineering.

B. Audit Methods

The audit team included an engineering graduate student and an environmental health specialist. The audit comprised two main steps:

1) Interview and data collection.

2) Shop walkthrough.

Step one consisted of an interview with the shop manager. The interview was designed to collect the following information:

1) General shop information (size, operations, etc.).

2) Shop processes.

3) Material safety data sheets.

4) Current waste management practices.

The interview was also designed to provide the shop manager with a description of the audit process.

In step two, the audit team and the shop manager conducted a visual inspection of the shop operations and processes. The audit team identified the processes generating potential hazardous wastes and investigated current waste management practices.

The approximately six hours of on-site consultation included no environmental sampling or industrial hygiene monitoring. All the information provided in this report is based on the interview, the walkthrough, and a review of the current and available waste reduction literature. Hazardous waste determinations were based upon a review of the material safety and data sheets, any existing laboratory reports, and EPA literature. Waste volume figures are based upon estimates made by the generator and the audit team during the shop walkthrough.

II. Shop and Tanning Process Description

The business audited is an Alaskan tannery which processes five to ten thousand skins per year for sportsmen and taxidermists. The owner manages a staff of four and has operated the business for seven years.

In general, tanning turns an animal skin into a material that resists bacterial decomposition. The tannery reviewed processes skins for fur dressing, meaning the natural fur remains attached to the skin, preserving its original appearance. The tanning process observed cannot be completely quantified because the quality of the processed skin depends also on the skill of the tannery personnel. The fur dressing process will be described in seven steps.

1) Arrival of the skins

When the skins arrive they are immediately inspected, fleshed and salted. When fleshing, unwanted flesh and fat are scraped from the skin. Currently the fleshing waste is being disposed of as a municipal solid waste.

Immediately after fleshing, salting is performed. Two thorough saltings occur within a 48 hour period for absorbing moisture and preventing bacterial growth within the skin. The application is based on experience and the quantity of salt consumed in this portion of the process needs to be established. Drying occurs after salting. It is an air drying technique that requires an inspection program to spot spoilage.

When a sufficient quantity of skins accumulates, a batch of skins moves through the remainder of the process.

2) Rehydration

A batch of skins, normally weighing about 105 pounds after drying, moves to the rehydration step. This step is needed to restore the skins pliability for further processing. The skins are placed in a 350 gallon solution of water, salt, wetting agent, sulphuric acid, and bactericide. Because of the bacteria buildup in the solution, it is dumped to the sewer and not reused. After removing the skins from the rehydration vat, the skins are hung over a beam for four hours which helps open the pores.

3) Washing

The skins are washed for one hour to remove the natural greases and non-leather forming proteins. The skins are placed in a rotating drum containing a 250 gallon solution of water, salt, soap, and grease solvent. Soda ash is added to maintain the pH between 9 and 10. Initially the "float," the tanning industry term for quantity of solution, is maintained at 125 gallons and later in the cycle it is increased to 250 gallons. Due to the

dissolved grease and other contaminants, the wash solution cannot be immediately recycled and currently it is being dumped to the municipal sewer. Because the wash cycle reduces the skins' resistance to bacteria, they must proceed immediately to the pickling step.

4) Pickling

Pickling prepares the skin for tanning by creating an acidic condition so the tanning agent can fix more readily to the hide proteins. The skins are placed in a drum and rotated for 16 to 24 hours with 250 gallons of solution containing water, salt, aluminum sulphate and sulphuric acid . The pH of the solution is maintained between 1 and 1.5. Presently, the same drum is being used for washing as well as pickling and the pickling solution is not used beyond one cycle.

5) Shaving

Next, in order to be handled for shaving, excess pickling solution is allowed to drain off the skins and into the floor drain. The shaving step involves hand trimming any excess hide that might interfere with the following tanning step. The leather scraps produced are disposed of as municipal solid waste.

6) Tanning

Tanning is the final primary processing step. The skins are loaded into a drum specifically designated for tanning. The skins are rotated in a 250 gallon, 35 C solution of water with a pH ranging from 3.4 to 4.0 and containing salt, aluminum sulphate, amonium sulphate, soda ash and water soluble oils. The tanning solution is currently being directly recycled up to 4 times before being dumped to the municipal sewer. Losses of tanning solution are as follows:

a) A 50% loss by weight of solution chemicals occurs due to retention within the skins and solution draining retention of chemicals within the skins and solution draining from the skins after removal from the drum; When removing the skins from the drum about 63 gallons of solution for 105 lbs (dry weight) of skins is lost.

b) an additional 25% of the remaining solution is dumped allowing room for heated solution needed to raise the temperature to 35 C; a total of about 110 gallons of fresh, heated solution is added each time a cycle is run.

7) Finishing

After tanning, the skins are drained and dried to a 25% moisture content. None of the tanning solution draining from the skins is recovered.

Next, the skins are tumbled in a baffled drum with hardwood sawdust to even out the moisture content and help open the pores for a later addition of oil. The sawdust (grade 4) in this step has been previously used three times with perchloroethylene, "perc," a degreaser. After this step the grade 4 sawdust is disposed of as municipal solid waste.

The skins are now beamed to further open the pores and then heated oils are brush applied. After oiling, the skins are folded and set overnight. The oiling is followed by tumbling in a baffled "kicking" drum to work in the applied oils.

The skins are now cleaned in three cycles by tumbling them in a drum containing a mixture of "perc" and hardwood sawdust. The quantity of sawdust used per cycle was not established, however, 1 liter of "perc" is consumed per cycle. The first cleaning uses grade 3 sawdust which has been used in two previous cleaning cycles. The pelts are then air dried. The second cleaning uses grade 2 sawdust which has been used in one previous cleaning cycle. The pelts are then beamed. The third and final cleaning uses fresh sawdust (grade 1), and corn starch; both the sawdust and the corn starch act as carriers for the "perc" and absorb grease and dirt. The perchloroethylene vapors vent directly into the workplace from the rotating drum. After the last cleaning, the pelts are tumbled in the "cage" drum. The cage drum also vents directly into the workplace.

All of the chemicals used by the shop are stored on the premises. Currently, the shop is receiving a materials safety data sheet from the chemical supplier for chemicals purchased. Chemical solutions are either discharged into the sewer after use or are kept in their process containers for another cycle. Chemical solutions occur in the following process steps:

Step		
2)	rehydration	(no recycle)*
3)	washing	(no recycle)
4)	pickling	(no recycle)
5)	tanning	(limited recycle)
7)	dry cleaning	(no recycle)

*(current practice)

III. Waste Generation

A. Waste Quantities by Process

Some of the wastes produced were described in the process description. Table III.1 shows in more detail the type and quantity of waste material within the tanning process. The quantity and type of material was gathered from an interview with the business owner. No sampling was performed.

Table III.1

Step	Waste Type	Quantity/Wk *
arrival of the skins	flesh and fat (biodegradable)	to be determined
	salt (NaCl)	to be determined
rehydration	wetting agent	7-14 lbs
	salt	147 lbs
	sulphuric acid (3.5 cups)	0.21 gallons
	water	1225 gallons
washing	soap	10.5 lbs
	solvent	14 lbs
	soda ash	3-10 lbs
	salt	147 lbs
	water	875 gallons
pickling	alum	70 lbs
	salt	455 lbs
	water	875 gallons
shaving	leather scraps	to be determined
tanning	alum	115 lbs
	amonium sulphate	26 lbs
	sodium acetate	to be determined
	soda ash	to be determined
	oil	to be determined
	salt	214 lbs
	water	525 gallons
finishing	"perc"	2-3 gallons
	sawdust	to be determined

* based on an average of 3 1/2 skin batches/week

Table III.2 lists the replacement value of the most used chemicals in the tanning process.

Table III.2

Chemical	($)Unit Price	Quantity	$/year
salt (this does not include the fleshing and drying salt)	8.50/80 lb	919 lb/wk	5077.
"perc" (perchloroethylene)	310./55 gal	3 gal/wk	880.
pickling solution (all chemicals)	.08/gal*wk	875 gal/wk	3640.
tanning solution (all chemicals)	.14/gal*wk	525 gal/wk	3822.

Most of the waste occurring at the shop is because process chemicals are difficult to reclaim from the spent processing solutions. Except for the tanning solution, after the skins are drawn from a process solution, all the remaining solution is discharged to the municipal sewer after one cycle. The solid waste produced is as follows:

a) fleshing
b) spent sawdust
c) spoiled pelts
d) leather strips
e) general workshop debris

B. Regulated Wastes

The solid waste generated is non-hazardous with the exception of the skin cleaning sawdust because of its contact with perchloroethylene, a regulated hazardous waste [1]. All of the spent chemical solutions are being accepted by the municipal sewer system. Neutralizing the pickling solution is a requirement before discharging to the sewer system. The solid waste is presently being deposited at the municipal landfill. In the Waste Generation Reduction Alternatives section, methods for reducing waste through chemical reclamation, process and equipment modification, and management practices will be presented. Also, the spent sawdust (grade 4) as a hazardous waste is discussed in the Waste Disposal Methods section.

IV. Waste Management

A. Waste Storage

A small quantity generator may not store hazardous wastes in quantities greater than 13,200 pounds longer than 180 days. The waste may be stored for 270 days if it has to be transported over 200 miles to a licensed hazardous waste facility. This case applies to Alaska, which has no approved hazardous waste disposal facility. Generators of less than 220 pounds per month of hazardous wastes are subject to the Small Quantity Generator Regulations if they store more than 2,200 pounds of hazardous wastes.

Hazardous wastes containers should be clearly labeled "hazardous wastes." The containers should also be marked with the date collection of the wastes began. The containers should be kept in good condition, closed and inspected once per week. The wastes, if ignitable or reactive, should be placed as far as possible from the storage's property line. The wastes may be treated on-site without a permit if:

1) They are treated within 180 days (for Alaska 270 days).

2) The containers conform to the regulation described in the above paragraph.

3) Steps are taken to prepare for and prevent accidents as described in the Small Quantity Generators Regulations.

Precautions should be taken to prevent accidents involving the hazardous materials stored on site. The regulations for the storage of hazardous materials and wastes were written to prevent accidental spills, fires, explosions, and release to the environment. The operator of a site should develop a contingency plan to deal with an accident involving the hazardous wastes being stored.

B. Waste Disposal Methods

Currently all spent chemical solutions are being discharged into the municipal sewer and the solid wastes are being disposed of at the municipal landfill.

The spent process solutions are being disposed of in the municipal sewer after satisfying the limitations set by the Local, State, and Federal regulations. The nature of the process solutions generated by the tanning industry can vary greatly due to differences in processing goals and the variety of chemicals being marketed. For instance, the goal of this tannery is to process fur and not produce leather, therefore, the use of chromium salts, a regulated toxic material important in forming leather, can be avoided.

The tannery generates about 3500 to 4000 gallons of spent

process solutions per week. The spent solutions contain on average .27 lbs/gal (32 gm/1) of salt (NaCl), the major process chemical in the spent solutions. The municipality requires neutralization of the pickling solution before discharging to the sewer. Of the chemicals used in process solutions, there appears to be nothing that would classify the waste solutions as toxic regulated hazardous wastes, requiring disposal at a licensed hazardous waste landfill.

The tannery generates an unspecified quantity of solid wastes which are disposed of at the municipal landfill. A trash dumpster is routinely collected containing fleshing wastes, leather strips, spoiled skins, "grade 4" sawdust and general workshop debris. Of the solid waste generated , those that came in contact with process chemicals need to be evaluated for their toxicity . For example sawdust waste absorbs perchloroethylene during the final skin cleaning step and contains an undetermined amount of "perc" after completing this step. By exposing the sawdust to perchloroethylene, a hazardous chemical, the sawdust is now considered a hazardous waste [2]. In the event a waste is found to be hazardous and requires regulated disposal, it must be isolated from the main waste stream to avoid contaminating a larger volume. Elimination of the waste through process modification is the best solution for a disposal problem and the sawdust waste generation situation will be discussed in the Waste Generation Reduction Alternatives Section.

If a facility produces a regulated toxic waste that cannot be eliminated from the process, every effort needs to be made to minimize its consumption within the process, and maximize its reclamation and its isolation from the general waste stream. For example, the "grade 4" sawdust must not be placed in the trash dumpster with other general wastes. It needs to be isolated in sealable drums and disposed of according to EPA guidelines.

Generally, there are three acceptable disposal methods for hazardous wastes:

1) Disposal in a licensed hazardous waste landfill.

2) Disposal in an authorized high-temperature incinerator.

3) Disposal to an authorized hazardous waste recycler.

None of these facilities are available in Alaska and all wastes must be transported to a disposal site approved by the EPA. The wastes must be shipped in containers and by haulers as prescribed by the Department of Transportation (DOT). A hazardous waste hauler should be able to offer assistance on assuring adequate packaging. The packaging requirements are described in the DOT regulations (49 CFR Part 172).

C. Costs

The costs of disposing hazardous wastes can vary with the

following factors:

1) Quantity and nature of the wastes.

2) Transportation distance.

3) Variations in prices charged by the haulers and disposal facilities for the transportation and disposal of hazardous wastes.

It may be advantageous to contact other generators of hazardous wastes to coordinate shipments and realize savings through bulk shipments.

In Alaska, there are no EPA approved hazardous waste management facilities. All hazardous wastes, as defined by RCRA, must be shipped out-of-state to an approved facility. The cost of shipping the hazardous waste increases the disposal costs considerably.

Comprehensive disposal costs for a 55-gallon drum of hazardous wastes generated in Alaska can cost up to $1,390. (Glean Inc.). See Table IV.1 for a cost breakdown. This is a very generalized estimate which assumes incineration as the disposal method. If the waste is disposed of in a landfill or by recycling, costs may be reduced. Also, as noted previously, the cost can vary depending on the hauler and the disposal facility.

The high disposal cost of hazardous wastes should be taken into consideration when purchasing raw materials and planning expenditures. Production processes and methods should also be analyzed to identify means of minimizing the generation of hazardous wastes and thereby disposal costs.

Table IV.1

Hazardous Waste Disposal Costs Estimate for One 55-Gallon Drum Generated in Alaska

Waste Determination (In State lab analysis)	$ 175.00
Transportation	$ 310.00
Disposal Site Profile (On site lab analysis)	$ 200.00
Waste Acceptance	$ 125.00
Incineration	$ 580.00
Total Cost	$ 1,390.00

V. Waste Generation Reduction Alternatives

A. Incentives

The private sector has many incentives to reduce its generation of hazardous and solid wastes, air emissions, wastewater and other wastes. Some incentives include:

1) **High Disposal Costs:** Strict hazardous waste legislation and high liability lead to disposal costs that can reach over $1000 per 55 gallon drum.

2) **Financial Liability:** Generators of hazardous wastes are liable for their wastes from production to ultimate disposal of the waste. This liability includes potential improper handling by the transporter or the disposal facility as well as any future sudden release from the disposal site.

3) **Public Relations:** Hazardous waste is a very timely issue. The public is concerned about the generation of all forms of hazardous and non-hazardous wastes. Attending to waste reduction can improve a business' public image.

4) **Saving money:** Waste reduction can limit resource expenditures and improve efficiency.

5) **Protecting Workers' Health:** Waste reduction and hazardous waste identification can reduce worker and community exposure to industrial wastes.

B. Waste Reduction Categories

Waste reduction techniques can be grouped into the following categories:

1) **Process Technologies:** This involves the use of innovative technology to reduce process wastes which can translate into reduced costs and increased productivity. For example technology within the tanning industry and from other industries can be used to recover pickling and tanning solution and perchloroethylene used in the skin dry cleaning process.

2) **Plant Operations:** These methods involve alterations in plant operations to decrease hazardous waste generation. Areas for investigation would be inventory control, efficient use of raw materials and more productive equipment.

3) **Plant Input Changes:** Another way to reduce hazardous waste generation is to utilize raw materials that will

not become hazardous wastes during the production process.

4) **In-Process Recycling:** These methods reclaim process material from the waste and channel it back into the production process. For example, tanning solution is currently being directly recycled and similar recycling can be accomplished with the pickling solution.

C. Potential Waste Reduction Opportunities

The tanning business was evaluated using the four waste reduction categories described in the previous section. The first category to be discussed is Process Technologies.

1) Process Technologies

The process technologies discussion will focus on the recovery of chemicals from spent solutions and the process modifications needed in the skin dry cleaning step.

Recovery of Chemicals from Spent Solutions

The process solutions are discharged to the sewer and cannot be reused indefinitely due to the build-up of contaminants such as dirt, hair and grease in the solutions. Recycling the solutions basically requires a reliable filter. In the late 1970's ultrafiltration (UF) was being investigated by the tanning industry to reclaim process chemicals in the spent solutions, however, UF is currently not commercially being used [3]. The research results and a description of ultrafiltration will be presented next.

UF is a relatively new technology which involves the use of a membrane that allows the passage of certain substances such as water and dissolved chemicals of small molecular size. Larger dissolved and suspended particles such as grease and dirt will not pass through the filter membrane and are isolated from the recoverable process chemicals. An advantage of UF is that a constant flow of fluid across the filter is maintained which inhibits the accumulation of filter cake; this reduces the maintenance costs and increases the filter efficiency. Initial treatment of the spent chemical solutions, using floatation/ sedimentaion chambers which allow floatable solids to be collected at the surface and settleable solids to fall out of suspension, would further improve filter performance. Recovery rates are reported at 95 to 99% of sodium chloride and 20 to 30% of the auxiliary process chemicals remaining in the spent solution [4].

The **rehydration solution** is currently being dumped after one use due to the bacteria buildup. Ultrafiltration can be used to reclaim the salt and other auxiliary chemicals, however, ultrafiltration will only help to minimize the bacteria problem

by removing the organic compounds which the bacteria feed from and are attached to. To combat the bacteria, analysis of the filtered solution would have to be made to determine the quantity of bactericide that may need to be added. Care must be exercised not to create another waste problem by adding bactericide.

The **wash solution** is currently being discharged to the sewer after one usage because of the build-up of organics removed from the skin during the wash process. Of the chemicals used to prepare the solution, salt would be most readily recoverable. Soaps and soda ash would be added to replenish the recycled wash solution. Combining the waste solutions from rehydration and washing for ultrafiltration processing should be investigated since this procedure increases the UF process efficiency and the waste solutions appear compatible.

The **pickling solution** can be directly recycled up to four times according to the owner, however, it is currently being discharged to the sewer after one usage because the same processing container is used for both washing and pickling. In terms of ultrafiltration, the spent pickling solution should be processed separately since the chemicals recovered would be incompatible with the rehydration, wash, and tanning solutions.

The **tanning solution** is currently being directly recycled up to four times before being discharged to the sewer. Ultrafiltration could recover tanning solution for recycling; it may need to be processed separately from the other spent solution due to chemical incompatibility.

In summary, the following points need to be considered when applying the use of ultrafiltration to recover chemicals from spent solutions:

1) Ultrafiltration (UF) is technically a proven method for reclaiming chemicals from spent tanning solutions but it appears not to be practiced in the U.S. [5].

2) Spent solutions may have to be processed separately using UF in order to maintain the desired chemical composition of the recycled solutions.

3) The recycled solutions would need to be analyzed to determine the quantity of chemicals needed to replenish the chemicals consumed during the skin processing.

A potential source of conventional filtration technology available locally is that used by the petroleum industry to recycle petroleum products such as transmission oils. Conventional filtration removes suspended solids only and cannot separate dissolved solids whereas UF separates both dissolved and suspended solids. Dirt and grease are examples of suspended solids and salt in solution is an example of a dissolved solid. The systems are designed for durability and simplicity allowing

them to be used with confidence in remote locations. The petroleum filter's technical and economic effectiveness for reclaiming spent process solutions needs to be established through research. A listing of conventional filter system suppliers can be found in telephone business directory under "Filters-liquid."

Process Modification of the Skin Dry Cleaning Step

Presently the final cleaning process uses perchloroethylene, "perc," as the cleaning agent. Perchloroethylene is a clear, colorless, nonflammable, hazardous liquid degreasing chemical having an etheral odor. The human nose normally detects concentrations between 5 parts per million (ppm) and 50 ppm. Exposure to concentrations greater than 200 ppm may cause vomiting, drowsiness and even the appearance resembling alcoholic intoxication [6]. Process modification of the skin dry cleaning step needs to be investigated to recover the valuable process chemical perchloroethylene, reduce worker exposure to perchloroethylene, and eliminate the contact between sawdust and perchloroethylene.

The equipment in use does not have the ability to recapture or isolate the "perc" as it evaporates during the cleaning process and generates a mixture of "perc" and sawdust, a controlled hazardous waste [7]. Dry cleaning equipment from the cleaning industry is available which not only isolates the evaporating "perc" from the workplace but can recapture it for recycling. This type of equipment, however, is not marketed for cleaning fur garments (skins) since it does not accommodate cleaning granules such as nutshells or sawdust mixed with "perc." Cleaning granules are needed for skin cleaning to act as a carrier for "perc," absorb oil and grease, and provide a gentle scouring of the skins.

The commercial fur cleaning equipment reviewed uses cleaning granules containing perchloroethylene as a degreasing agent. It produces 2 lbs of spent cleaning granules per 4 fur garments [8] and due to the "perc" contained in the cleaning granules, a hazardous solid waste is generated. A degree of recycling is accomplished by redirecting exhaust from the cleaning process back into the drum while the machine is operating, however, the extent to which this machine isolates "perc" vapor from workplace needs to be established.

Another approach to reducing "perc" vapor in the tannery shop is to enclose the present location of the cleaning drums and pull air from the enclosure through an activated carbon filter system or a refrigeration process. It is possible to reclaim "perc" from both types of systems. Since "perc" vapor is heavier than air, the air intakes for the ventilation system should be located near the floor. Such ventilation devices for reducing extraneous "perc" vapor which escape from the dry cleaning process are used within the cleaning industry [9].

Further reduction of "perc" vapor in the workplace can be accomplished by simply isolating the sawdust processed with "perc" in a sealable drum.

Venting the "perc" vapor outside the shop would merely be an uncontrolled method of disposal. Possible repercussions could be a toxic build-up over time of "perc" in the soils immediately below the plume of discharged vapor.

The following is a summary of items to be considered while making the needed process modifications for skin cleaning:

1) Maintaining the quality of the finished skin.

2) Keeping the perchloroethylene vapor levels below 50 ppm for worker health and productivity.

3) Recovering perchloroethylene and reducing or eliminating the generation of a solid hazardous waste.

4) Use of another less hazardous degreaser.

The models of commercial fur cleaning equipment reviewed was limited but the following conclusions will be made:

1) The use of cleaning granules containing "perc," a solid hazardous waste, is not avoided although it may be reduced from the present levels.

2) Auxiliary equipment such as an activated carbon filter and a ventilation system would be needed in addition to the primary fur cleaning machine to limit "perc" vapors in the workplace and recover a percentage of the "perc" consumed.

2) Plant Operations

Waste reduction can also be accomplished by investing in new equipment. The pickling, tanning and skin cleaning steps could benefit from equipment modifications and replacement.

Pickling Solution

Presently the pickling solution is being dumped after one cycle even though it could be directly recycled up to four times. This is because the same processing drum is used for washing as well as pickling. By installing another processing drum, consumption of pickling chemicals could be reduced.

Reclamation of picking solution using a centrifuge will be discussed in the next section.

Tanning Solution

After a batch of skins completes the tanning step, a portion of the remaining solution is dumped to allow room for heated solution. The heated solution is needed because the remaining solution has cooled below 35 C, the required processing temperature. The recycleable solution is reheated by adding hot water and sufficient chemicals to replenish the tanning solution. To avoid wasting a portion of the remaining solution for reheating, a heating element could be used to reheat the solution.

Further reclamation of tanning as well as pickling solution could occur by using a centrifuge. A 50 lb capacity centrifuge available from the commercial laundry industry would cost about $7,200. and remove approximately 50% of the solution remaining in the skins [10]. The chemical composition of the recovered solution would need to be established. If the tanning or pickling solution reclaimed is less than four cycles old it could be returned to the processing container. A centrifuge could also recover a portion of the solution contained in skins removed from the rehydration and washing containers. If UF processing were available, the centrifuged solutions would be placed with other compatible solutions in a settlement chamber before filtering.

An additional benefit of the centrifuge would be reduction of drying time after the skins are removed from the process solutions. A further consideration is whether the quantity of solution remaining in the skins after centrifuging is compatible with the next processing step.

Skin Cleaning

As discussed in the Process Technology section, more sophisticated equipment from the dry cleaning industry needs to be investigated for possibly replacing or modifying the present dry cleaning equipment.

Another waste product from skin cleaning normally not considered to have commercial value is the flesh and fat scraped from the skins when they first arrive. This flesh and fat as well as other skin scraps produced during the skin's processing contain complex organic compounds with more potential than filling a city landfill. The useful compounds of commercial value are collagen, a fibrous protein, and grease. In large leather producing tanneries, 40 to 50% of the skin entering the tannery ends up as solid waste. The collagens recovered from this waste stream are used in the production of medical products, absorbants, filtering materials, beauty creams and lotions, and paper. Recovered grease is used in the production of soaps and detergents. The plant operations involved in recovering collagen and grease and the quantity of wastes needed for commercial success are beyond the current capacity of the skin dressing tannery being reviewed, however, the flesh and fat scraped from

the skins as they first arrive could be investigated for use as an animal feed. A potential consumer of the feed would be the Alaska Zoo.

In summary, the following are the considerations recommended for modifying plant operations to achieve waste reduction:

Equipment	Process step
process drum	pickling
heating element	tanning
centrifuge	allprocesssolutions
filters (UF)	all process solutions
settlement chambers	all process solutions
dry cleaning equip.	skin cleaning
sealable drums	skin cleaning (spent sawdust)

The Process Technology section discusses filtration and dry cleaning in more detail. Ultrafiltration and settlement chambers are technologies that do not appear to be practiced commercially on a large scale in the U.S. tanning industry.

3) Plant Input Changes

Changes in process chemicals were examined in view of their potential for reducing waste toxicity . During the audit, one particular chemical, perchloroethylene, used in the final skin cleaning step, was seen as a potential health hazard because it freely vented to the workplace from the cleaning drum and it was absorbed by the sawdust. To date no non-hazardous chemical appears to be commercially available to replace "perc" and the contact between "perc" and a cleaning granule (sawdust) is essential to the current skin dry cleaning process [11].

The commercial skin dry cleaning equipment reviewed uses a premixed quantity of "perc" and a cleaning granule. This process does not eliminate the generation of a hazardous waste but eliminates the need for mixing and storing liquid "perc," a source of "perc" vapor escaping to the workplace. The quantity and cost of the wastes generated by the present cleaning granule and the commercial cleaning granule need to be compared in order to verify any savings that could occur by switching to a premixed cleaning agent.

4) In Process Recycling

Waste generation is also reduced by directly recycling process materials. Presently the tanning solution is being directly recycled up to four times with replenishment of the process chemicals. As discussed in the Plant Operations section, increased direct recycling of process solutions can occur with tanning and pickling solutions through installation of a heating element and another processing drum. In addition, sawdust, the skin dry cleaning granule, is used four times before being disposed of.

Indirect recycling of all process solutions using ultra filtration is theoretically possible but not commercially practiced in the U.S. Perchloroethylene can also be recovered by modifying technology from the dry cleaning industry. Indirect recycling is also discussed in the Process Technology and Plant Operations sections.

D. Feasibility Analysis for Recovering Process Chemicals

To determine the feasibility of recovering process chemicals, a technical and an economic evaluation should be made. The technical evaluation will determine if the proposed equipment will produce a quality product or service. Table V. 1 lists guidelines for determining technical feasibility [12]. To determine a system's technical feasibility it is often necessary to carry out an on-site test or other operational testing.

Table V. 1

- Is the system safe for workers?
- Will product quality be maintained?
- Is space available?
- Is the new equipment, materials or procedures compatible with current production operating procedures, work flow and production rates?
- Is additional labor required?
- Are utilities available or must they be installed?
- How long will production be stopped in order to implement the system?
- Are special skills needed to operate or maintain the new system?
- Does the vendor provide acceptable service?
- Does the system create other waste problems?

In performing an economic evaluation, the various costs and savings for a technically feasible waste reduction proposal are considered. The economic evaluation proceeds by breaking the expenditures into capital and operating costs. The savings are determined by comparing the present capital and operating costs with those of the waste reduction proposal. Profitability of the savings is determined using methods such as payback period, return on investment and present or future value.

A simplified economic evaluation using the payback method will be presented for adding a process drum to the pickling step. Cost estimates were determined using information obtained from the shop audit.

Process drum installation and purchase	$2500.
Current pickling solution cost	$3640./yr
Unrecoverable loss of process chemicals	50%
Annual cost savings (materials only) ($3640. x 50% = $1820.)	$1820./yr

$$\text{Payback} = \frac{\text{capital costs}}{\text{annual cost savings}} = 1.4 \text{ years}$$

1) Process Chemical Recovery From Spent Solutions

Tanning industry sources [13] report an ultrafiltration system capable of handling 5000 gal per day would cost about $75,000 (1979 prices); installation costs would increase the total capital costs to $112,500. Maintenance and labor would make up about 15% of the budget. This far exceeds the combined spent solution output of this study's tannery which is at about 3,500 gallons per week. New Method Fur Dressing, a fur dressing company contacted in San Francisco, generating over 1000 gallons/day reportedly does not reclaim any of its process solutions.

Conventional filtration systems are available at a modest cost from local suppliers. One particular system has a base price of $80. and is rated at 5 gpm. These systems, unlike UF, would not separate dissolved solids but would also have longer filter runs if operated in conjunction with a chamber designed to separate floatable and settleable solids. Clearly this is an area where research needs to be done to establish technical and economic feasibility; sources for funding could be from a proposed Department of Environmental Conservation revolving loan program (HB 476 & 477) designed to help small business in their waste reduction efforts. Technical assistance could be obtained through the University of Alaska, Anchorage Engineering Department or the Alaska Health Project.

2) Recovery of Perchloroethylene

The commercial fur cleaning machine reviewed in the previous sections cost $3,975. uninstalled and has the following characteristics:

1) Uses 3 lbs of premixed cleaning compound per cycle

2) "Four garments" per cycle.

3) Auxiliary equipment to control and reclaim "perc" vapor is anticipated.

Costs for the additional equipment to recover and control "perc" vapor were not obtained. The two major elements needed to recover and control "perc" would be a recovery process and a collection system. The recovery process could be an activated carbon filter or a refrigeration process. A ventilation system is needed to collect fugitive "perc" vapor from the cleaning process and the storage area for perchloroethylene and "perc" contaminated material (i.e. processed sawdust) and direct it to the recovery process.

VI. Summary and Conclusion

The quantity and characteristics of the wastes generated by the tannery described in this audit were determined with information provided by the owner/operator at the time of this audit. The tannery may, in actuality, generate wastes other than described in this report. Changes in processes, equipment and chemicals will affect the amount of wastes generated.

The tannery process in this audit was found to generate the following wastes:

Waste	Quantity	Waste Destination
shop debris, spoiled skins, fleshing, leather strips & sawdust	unknown	municipal landfill
tannery process solutions	3500 gal/wk	municipal sewer (limited recycle)
perchloroethylene	55 gal/month	
- vapor		- venting freely to the workplace
- liquid		- residual in the sawdust

The major component of the process solution is salt (NaCl) at an average concentration of .27 lbs/gal (32 gm/l). The spent process solutions are being discharged to the municipal sewer system. The pickling solution requires neutralization before discharging to the sewer.

Of the wastes produced, processed sawdust was determined to be hazardous due to its contact with perchloroethylene. Disposal is required at a licensed hazardous waste disposal site, which would mean transporting the waste to a site outside of Alaska. Private carriers for transporting hazardous wastes are currently charging $400 to $500 per 55 gallon drum; final disposal costs would vary according to the method of disposal. The Municipality's hazardous waste receiving facility is scheduled to open in the Fall of 1988 and should reduce disposal costs for Small Quantity Generators. It is important to isolate the contaminated sawdust from the remaining solid wastes to avoid creating an unnecessary increase in the quantity of hazardous wastes to be disposed of. The quantity of sawdust exposed to "perc" needs to be established in order to verify the tannery as a Small Quantity Generator.

From the process description it was determined that a total of approximately 11 gallons/month of perchloroethylene is consumed (1 L/cleaning cycle x 3 cleaning cycles/batch x 3.5 batches/week x 4 weeks/month = 42 L/month = 11 gal/month), which does not agree with the consumption value given by the owner of 55 gallons/month. This discrepancy needs to be resolved; it may

be due to an error in data reporting rather than spillage. The mixing and storage of liquid "perc" could be avoided by using commercial, premixed, cleaning granules specially formulated for skin cleaning.

In order to effectively manage the perchloroethylene vapor in the workplace, reclaim a portion of processed "perc," maintain quality cleaning of the skins and minimize the contact between perchloroethylene and sawdust, equipment from the dry cleaning industry should be investigated to possibly modify or replace the present skin cleaning equipment. Commercial fur cleaning equipment does not eliminate the contact between a cleaning granule (sawdust) and perchloroethylene. The quantities of spent processing materials from the tannery's present skin dry cleaning process needs to be established in order to further evaluate the savings commercial skin dry cleaning equipment could provide. The technical and economic feasibility of modifying commercial dry cleaning equipment to the tannery's needs more evaluation. Also, New Method Fur Dressing of San Francisco did not provide any useful information about their final skin cleaning process. Information given by New Method Fur Dressing is limited to the following:

- They neutralize spent processing solutions as required before discharging to the city sewer.

- They maintain experimental research within their processing.

Quantities of directly recycleable solutions could be substantially increased by investing in a heating element, a pickling processing drum, and a centrifuge.

Direct recycling of the tanning solution is occurring to a limited extent. Use of a heating element could eliminate the practice of dumping recycleable tanning solution to allow volume for heated, unused tanning solution.

The pickling solution can be used up to four times, however, because the same processing drum is used for both washing and pickling, the pickling solution is discharged to the sewer after one use. Installing another processing drum or a storage container specifically for pickling solution would allow for its direct recycle. A centrifuge would further increase the quantity of pickling and tanning solution for recycle by extracting solution contained in the skins pulled from the processing drum.

European research accomplished in the late 1970's successfully applied ultrafiltration (UF) technology to reclaim process chemicals from spent solutions. Presently UF is not being used within the U.S. tanning industry to any great extent because it has not become economically feasible.

Inexpensive conventional filter systems are available locally and need to be investigated as to their ability to

reclaim spent process solutions. To minimize the tannery's risk, research assistance from the Alaska Health Project and the University of Alaska, Anchorage could be combined with a Department of Environmental Conservation revolving loan (pending passage by the State Legislature to establish the funding) to determine the conventional filter systems technical and economic viability.

In summary, the tannery audited should investigate and be aware of the following to further minimize waste generation:

1) Install a processing drum specifically for pickling to directly recycle this solution.

2) Install an "extractor," a cleaning industry centrifuge, to reclaim pickling and tanning solution which can be directly recycled.

3) Install a heating element to heat the tanning solution for recycle.

4) Install sealable drums to store processed sawdust and contain "perc" vapor.

5) Analyze current consumption of perchloroethylene and sawdust to minimize the quantity of hazardous waste generated.

6) Consider using a premixed cleaning compound to avoid mixing and storing liquid "perc," possibly reduce the volume of "perc" contaminated hazardous waste, and help minimize "perc" vapor in the workplace.

7) Further evaluate the potential for modifying the present dry cleaning process using technology from the dry cleaning industry to minimize "perc" vapor in the workplace and reclaim a portion of "perc."

8) Currently, ultrafiltration is not economically viable but the technology is available and should remain a consideration.

9) Investigate the possibility of providing Alaska Zoo or local farms with fleshing material to reduce solid waste volumes.

10) Establish an on-going, in-house waste reduction team to implement and evaluate new waste reduction options.

11) Train all workers to be more knowledgeable about conserving raw materials and waste reduction methods.

In general, conducting an in-house or contracted

environmental audit can be an excellent means to identify and minimize waste generation and to improve the overall plant efficiency and working conditions.

VII. References

[1] Documentation of the Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, Inc., Cincinnati, OH, 5th edition, 1986, pg. 464-465

[2] Jim Sweeney, Hazardous Waste Coordinator, Solid Waste Service, Municipality of Anchorage, Anchorage, AK

[3] Frank Rutland, American Leather Chemists Asso., Tanners Council Research Laboratory, University of Cincinnati, Cincinnati, Ohio

[4] (Frank Rutland, University of Cincinnati)

[5] M. Campbell and W. Glenn, Profit from Pollution Prevention, Pollution Probe Foundation, Toronto, Ontario, Canada, 1982, pg. 270

[6] (Documentation of the TLV and Biological Exposure Indices, pg. 464)

[7] (Jim Sweeney, Hazardous Waste Coordinator, MOA)

[8] "Airmatic Drummaster" (fur cleaning machine), Haertel Company, Minneapolis, MN

[9] Dick Wells, Automated Laundry Systems, Inc., Anchorage, AK

[10] (Dick Wells, Automated Laundry Systems)

[11] (Dick Wells, Automated Laundry Systems)

[12] The EPA Manual for Waste Minimization Opportunity Assessments, Hazardous Waste Engineering Research Laboratory, EPA, Cincinnati, Ohio,EPA/600/2-88-025, pg. 19

[13] (Profit from Pollution Prevention, pg. 272)

VIII. Appendix A

Synopsis of the Small Quantity Generators Regulations

Facilities producing between 220 and 2200 pounds of hazardous wastes per month are subject to the Small Quantity Generator regulations. These regulations will require waste producing facilities to:

1) Identify the hazardous waste produced.

2) Obtain an EPA identification number.

3) Ship hazardous wastes for treatment, storage, or disposal in EPA approved facilities. The shipment will have to meet the requirements set by the Federal Department of Transportation for hazardous wastes. In addition the shipment will have to be accompanied by a manifest containing the generator's name and address, the shippers name, and the name and address of the receiving facility.

4) The hazardous wastes should be offered, at least every 180 days, to shippers and disposal facilities with an EPA identification number. In Alaska, because there are no EPA certified hazardous waste disposal sites within 200 miles, the waste can be stored for 270 days. The maximum weight of the wastes being stored, however, cannot exceed 13,200 pounds.

5) Finally, the waste generator should keep a copy of the shipping manifest for three years.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

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WASTE MANAGEMENT BRANCH

REPLY TO
ATTN OF: M/S 530

David Wigglesworth
Alaska Health Project
417 W Eighth Avenue
Anchorage, Alaska 99501

Dear Mr. Wigglesworth:

This is in reply to your question regarding information required by the Alaska Health Project's small quantity generator study. The purpose of this project is to study general waste management procedures and processes for specific small quantity generator categories. We hope to identify common current waste practices that can be better managed, and/or methods where waste generation can be minimized.

Because we wish the study results and recomendations to be as widely applicable to other generators as possible, we would like to obtain information which characterizes the representative generators you are studying. We do not feel any facility-specific identifiers will be necessary, but we would like any information on the facility type, process, size of operation, and/or any other information which would have bearing on the usefulness or extrapolation of the data to other generators, both in and outside of Alaska.

If you have further questions, please feel free to contact me.

Sincerely,

Joan Cabreza
RCRA Program Development